

## The Effect of Endurance Exercise on Alpha Amylase, PH and Cortisol Level of Saliva

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### Abstract

**Background and Aim:** Exercise is one of the activities to achieve fitness; therefore it should be performed in an appropriate way and its side effects should be minimized. It has been mentioned in the literature that in physiologic activities, there are important factors in the serum and saliva which have a significant role in dental and oral health, especially on dental caries. In this study, we decided to figure out how these oral health related factors are altered in endurance exercise.

**Materials and Methods:** In this study, the samples included nineteen 18 to 25-year-old beginner male athletes. Two samples of saliva were taken, one before running for control and one after 1000 meters for test. Salivary pH was digitally measured immediately after collecting the samples. Cortisol and alpha amylase of the saliva in both control and test samples were evaluated by ELISA method. Data were analyzed with SPSS software and evaluated with descriptive statistical methods.

**Results:** Endurance exercise in beginner athletes increased the mean alpha amylase level in their saliva from 59.57 to 107.52 IU/mL and the salivary cortisol from 2.73 to 3.60 Ng/mL. The mean salivary pH showed a 0.56 decrease ( $p < 0.001$ ).

**Conclusion:** There was an increase in the salivary cortisol and alpha amylase level and a decrease in salivary pH after endurance exercise.

**Key Words:** Cortisol, Alpha amylase, Salivary pH

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### Introduction

Exercise is performed to keep the body in a healthy state, therefore minimizing its probable adverse effects is of paramount importance. Existing literature indicates that important factors that can influence oral and dental health such as alpha amylase, cortisol, and lactic acid change during physiologic activities in serum and saliva. Merck and colleagues evaluated changes in salivary cortisol level during three types of physiologic pressure in 2007. In all three types of

activity, there was an increase in glucocorticoid level [1]. Shoukat et al stated in an article in 2008 that salivary acidity and lactate content has a positive and intense relationship with severity of physical activity [2]. Petering and co-workers evaluated levels of salivary alpha amylase and IgA before and after sports activities showing a significant increase in amylase levels, an enzyme with an important role in cleavage of carbohydrates within the mouth [3]. Since these factors have important direct and indirect roles in cari-

ogenesis, this study was conducted with the objective of evaluation of changes in salivary alpha amylase, acidity and cortisol content during an endurance exercise.

### Materials and Methods

A number of 19 volunteer novice dentistry students performing endurance exercises in Isfahan, Iran were randomly selected from a total number of 100 and involved in this interventional study. Exclusion criteria were defined as cardiovascular and respiratory diseases, aspirin and acetaminophen intake within 48 hours, history of Addison's and Cushing's diseases, and cortisone and steroid intake of more than 20 mg within the previous 6 months. An observational and non-contributing type of sampling was performed in a certain gymnasium. All participants ran in a fixed time with equal velocities and on a fixed line under equal moisture and environmental conditions. All saliva samples were taken at 11 a.m. Participants were prohibited to receive food or drinks except for water 2 hours prior to the sampling procedure. Participants were included after signing an informed consent. A saliva sample was taken from each individual at rest to control acidity, cortisol and alpha amylase content. Saliva samples were collected using Intube technique for 5 minutes. In this technique saliva was collected from different parts of the mouth and poured in a specific collecting tube via a disposable funnel. Then pH of the saliva sample

was digitally measured immediately with an accuracy of 0.01. The tubes were closed and stored in a cool place to prevent gas exchange. Care was taken for all individuals to traverse the 1000-meter path and reach the endpoint with their slow speed simultaneously. Individuals who were not able to do so were excluded from the study to equalize participants in terms of exercise intensity. Other samples were taken immediately and five minutes after cessation using the same technique. Samples were stored in a cool place before being transferred to a laboratory for centrifugation and disinfection. Cortisol and alpha amylase content of the samples were measured using specified ELISA kits (Pars, Tehran, Iran) according to the manufacturer's recommendations. Collected data were subjected to descriptive and *paired t* statistical tests using SPSS software.

### Results

The mean salivary cortisol level changed from 2.73 ng/mL before endurance exercise to 3.60 ng/mL after the procedure. This difference was considered statistically significant. The pre- and post-exercise salivary alpha amylase levels were 59.57 and 107.52 IU/mL, respectively. Such increase in salivary alpha amylase level was also considered statistically significant. The mean salivary pH significantly decreased during exercise from 6.84 to 6.28. ( $p < 0.001$ ) (See table 1)

**Table 1:** The mean levels of salivary cortisol, alpha amylase, and acidity in control and test groups

Variable	mean	Standard deviation	number	P.V
(control) cortisol Nanograms per milliliter	2/73	0/90	19	0/001>
(test) cortisol Nanograms per milliliter	3/60	1/30	19	0/001>
(control) Alpha-amylase IU/mL	59/57	38/37	19	0/001>
(test) Alpha-amylase IU/mL	107/52	47/95	19	0/001>
(control) acidity	6/84	0/267	19	0/001>
(test) acidity	6/28	0/283	19	0/001>

## Discussion

Exercise has a pivotal role in health and fitness. Endurance exercises cause significant changes in different factors in plasma and secondarily saliva, due to severe physical involvements. One of the factors that undergo such changes during exercise activities is cortisol. This study showed that salivary cortisol level is significantly enhanced following exercise activities. ( $p < 0.001$ ) Del Correl and Mahon indicated that aerobic exercise causes an increase in cortisol levels in plasma and secondarily in saliva. They also showed the distinct relationship between changes in cortisol levels in plasma and saliva [5]. This finding is quantitatively similar to the findings of our study. On the other hand, Luci and colleagues showed that no increase was observed in cortisol levels of professional and experienced athletes [6]. It is noteworthy that Luci et al's investigation is conducted upon professional athletes. It can be assumed that continuous professional exercise does not have such effects upon cortisol levels. Basically, emotional stress is considered as a major external factor that directly contributes to stimulation and secretion of cortisol. Within the current context stress is considered a psychologically or physiologically intense event rather than a mild or instantaneous one. In case exercise is considered a predetermined stress, increased plasma concentration of cortisol in varying amounts is observable in different exercise activity types. Studies show that the longer the duration of exercise activity, the higher the level of cortisol [7]. On the other hand, in long-term exercise activities, launching an aerobic system as well as oxidation/reduction reactions through which lipids are used as primary nutrition and energy sources is required. In such circumstances, the role of cortisol as the most important lipid recruitment and transfer hormone to the blood stream and finally muscular cells cannot be overemphasized. In addition, plasma cortisol provides 18 necessary amino acids for mutans streptococci within the dental plaque through degradation of proteins as addi-

tional energy sources under a physiologic stress state [8]. Use of fatty acids in such circumstances causes a decrease in pH of extracellular fluid [4,9]. According to the fact that saliva is a filtrate of plasma, such circumstances can occur in saliva as well. The results of the present study corroborate this fact, so that salivary acidity was shown to be significantly decreased following the exercise activity. Shaukat and co-workers conducted a study concerning pH of extracellular fluid during exercise activity and indicated that acidity and lactate content have intense and positive relationship with severity of physical activity [2]. Also Garret et al demonstrated that sympathetic stimulations such as exercise conditions significantly enhance salivary alpha amylase levels – the protein that degrades high-caloric starch-containing foods into simple carbohydrates useful for bacterial species [10]. The results of the current study confirms this fact so that a significant increase in salivary alpha amylase level was observed following the exercise activity.

## Conclusion

It can finally be concluded that some factors which are important in oral and dental health, including cortisol, alpha amylase and acidity, undergo significant changes during an aerobic endurance exercise activity.

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